GE 110

Question 1 given & find

(a) A motorist driving in the United States drives for 2 hrs and 40 min at an average speed of 55 mph and uses 6.5 U.S. gallons of gasoline. Determine her average rate of gasoline consumption in L/100 km.

Solution 1 US gallon = 3.7854 L

$\frac{6.5 \text{ gal}}{1 \text{ gal}} = \frac{?}{3.7854 \text{ L}}$

? = 24.6051 L used

1 mil = 1.6093 km

$\frac{5 \text{ mil}}{1 \text{ mil}} = \frac{? \text{ km}}{1.6093 \text{ km}}$

? = 88.5115 km/h

$88.5115 \text{ km/h} \quad \frac{236.03096 \text{ km}}{2.667 \text{ h}}$

$\frac{40 \text{ min}}{60 \text{ min}} = \frac{2}{3}$

236.03096 km traveled

she used 24.6 L

went 236.03 km

$\frac{L}{\text{km}} = \frac{24.6 \text{ L}}{236.03 \text{ km}}$

$= .104245646 \text{ L/km} \times 100 \text{ km}$

$= 10.42456 \text{ L/100 km}$

She use 10.4 L/100 km ✓

(b) What are the coordinates of the point of intersection of the two linear functions y = 3x - 4 and

f(x)

2y = x + 3? → $y = \frac{x}{2} + \frac{3}{2}$

y	x
2	1
3	3
2.5	2
2.55	2.1
2.6	2.2

$y = \frac{2.2}{2} + \frac{3}{2}$

$y = 2.6$

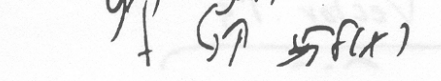
g(x)

y	x
-1	1
5	3
2	2
2.3	2.1
2.6	2.2

$y = 3(2.2) - 4$

$y = 2.6$

the coordinates of intersection are (2.2, 2.6)

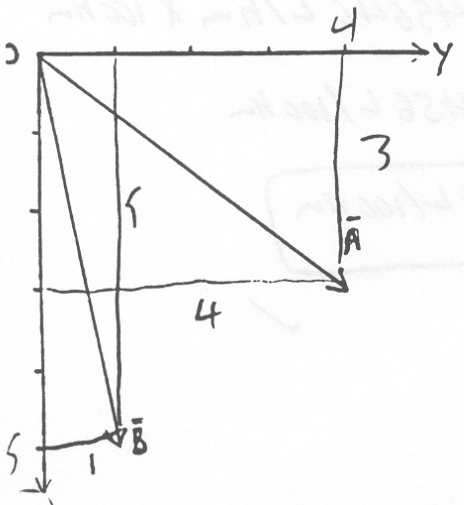


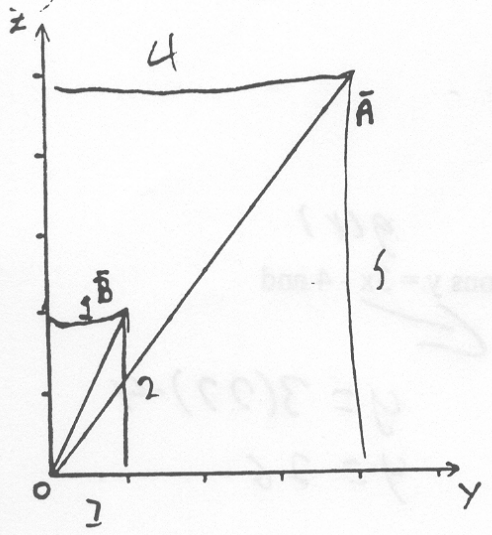
Question 2

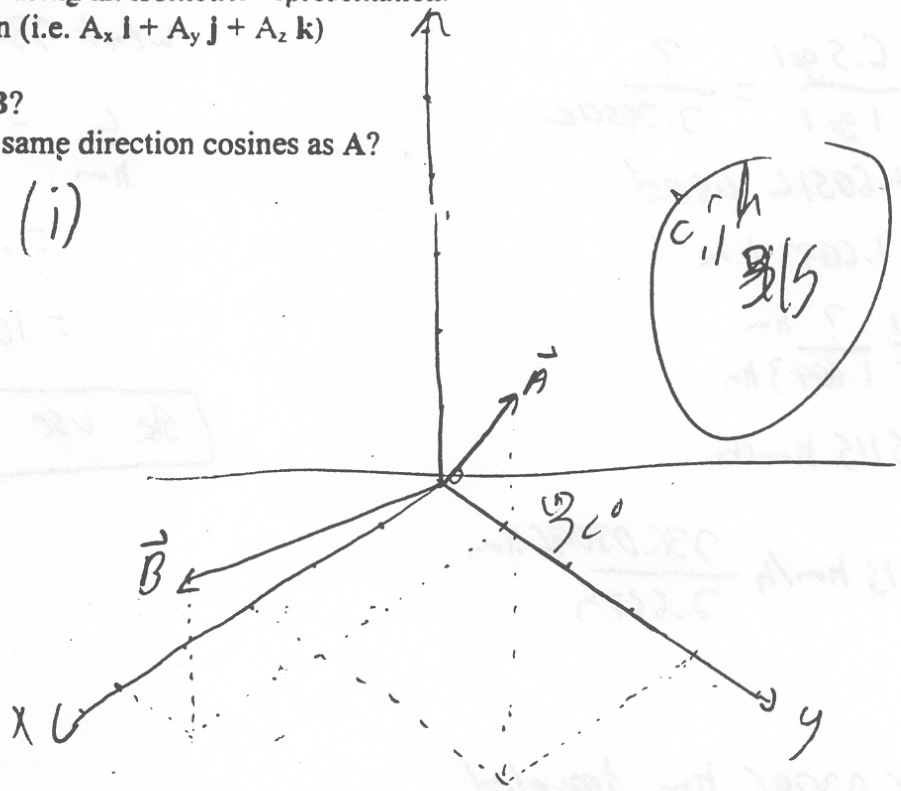
Shown is the orthographic (2-view) projection of two vectors A and B

(i) Sketch freehand the vectors to scale using an isometric representation.
(ii) Write each vector in i, j, k notation (i.e. $A_x\,\mathbf{i} + A_y\,\mathbf{j} + A_z\,\mathbf{k}$)
(iii) What is the length of B?
(iv) What is the angle between A and B?
(v) What is the unit vector that has the same direction cosines as A?

(i)







(ii) $\vec{A}$ in $\hat{i}\,\hat{j}\,\hat{k}$

$\vec{A} = \{(3\hat{i} + 4\hat{j} + 5\hat{k})\}$ units

$\vec{B} = \{(5\hat{i} + 1\hat{j} + 2\hat{k})\}$ units 5

(iii) $B = \sqrt{i^2 + j^2 + k^2}$

$= \sqrt{5^2 + 1^2 + 2^2}$ 5

$B = \sqrt{30}$ units

iv) $A = \sqrt{3^2 + 4^2 + 5^2}$ units

$= \sqrt{50}$ units

$= 5\sqrt{2}$ units

$B = \sqrt{30}$ (from iii)

distance from A to B

$AB = \sqrt{(i_A - i_B)^2 + (j_A - j_B)^2 + (k_A - k_B)^2}$

$= \sqrt{(3-5)^2 + (4-1)^2 + (5-2)^2}$

$.74677C = \cos AB$

$AB = 41.5°$ 5

(v) Cosines of A is line $\bar{A}$ in the top diagram you gave us because $\cos = \frac{adj}{hyp}$ and A is hyp

So the unit vector is

Question 3

(a) Circular sheets of metal 700 mm in diameter are used to be used for stamping highway signs. Calculate the percentage of metal wasted if the sign is to be largest possible square that can be made from each circle.

$\sin 45 = \frac{opp}{70cm}$

49.497cm is the base and height

$A_{square} = bh$

$= (49.497cm)^2$

$= 2450cm^2$

$A_{circle} = \pi r^2$

$= \pi(35cm)^2$

$= 3848.45cm^2$

total of $3848.45cm^2$

only use $2450cm^2$

$\frac{used}{total} \times 100\%$

$\frac{2450cm^2}{3848.45cm^2} \times 100\% = 63.66\%$ used

$100\% - 63.66\% = 36.338\%$

36.3%

3848.45cm²

36.3% of the metal is wasted

15

(b) Two engineering students paddling a canoe can maintain a constant speed, v, in still water so that it takes one hour to cover a certain distance. In a river , it is found that traveling with the current using the same power, the canoe can cover the same distance in 20% less time, whereas when traveling against the current it takes 30% more time. What is the ratio of the speed of the current, s, to the speed of the canoe in still water, v?

1 km/h

$\frac{1 km}{.8h} = 1.25 km/h$

$\frac{1 km}{1.3} = .769 km/h$

$1.25 km/h - 1 km/h = 0.25 km/h$

$.769 km/h - 1 km/h = -0.231 km/h$

$.25 km/h$

$.231 km/h$

20% less time

60 min × .2 = 12 min less

30% more time

60 × .3 = 18 min more

ratio

current speed : canoe in still water

0.24 km/h : 1.0 km/h

0.24 : 1.0

10

Question 4

Estimate (a) the weight and (b) the volume of the total number of text books that you will use to complete your engineering degree. Use S.I. units. State and justify all your assumptions.

- I will take 11 classes a year
- on average I think for 1 class the weight of texts will be 2.3kg (My GE 110 text is ≈ 2.3kg)
- on average I think for 1 class the volume of texts will be 3cm x 20cm x 27cm (My GE110 text measurements)
  = 1620cm³
- I hope to be her 4 years

Solution

4 years x 11 classes = 44 texts needed

44 text x 2.3kg = 101.2kg

44 texts x 1620cm² = 71280cm³

$71280\text{cm}\left(\frac{1\text{m}}{100\text{m}}\right) = 717.8\text{m}^3$ THINK !!! -5

(I know you may need more then 1 text for each class ✓
but I don't think all classes have as big as text
as GE110 so I My # at the top are for all texts
in 1 class)

(a) 101kg
(b) 713m³

-units -5

15

$71280\text{cm}\left(\frac{1\text{cm}}{100\text{cm}}\right)\left(\frac{1\text{cm}}{100\text{cm}}\right) = 7.13\text{m}^3$

101 x 9.81 = 990.8 N